

Oregon Malignancy Pattern and Radioisotope Storage

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AN INCREASED mortality rate for cancer, including leukemia particularly, among Oregon residents near the south bank of the Columbia River or along the Pacific Coast was reported recently by Fadeley (1). This would be an important observation if it were confirmed, because there is an increase in the radioactive content of water which flows through or past the Hanford (Washington) Atomic Storage Preserve before it is carried downstream past the areas which Fadeley reported to have high mortality rates. Because of the following features of his report, however, we have re-examined the question.

1. Several inland counties were omitted without explanation in the analysis.
2. Basic data (numbers of deaths) were not reported, and random variations of rates calculated on the small numbers of deaths occurring in single counties were not considered.
3. Although the age and sex structure of the population varies from one county to another, the rates were neither age adjusted nor sex adjusted.
4. The fact that throughout the United States and in many other countries cancer mortality rates are higher in cities than in rural areas (2, 3) was not mentioned. The river and Pacific counties generally are more densely populated than the inland counties, and, on this basis, they might be expected to have higher rates.
5. No study was made of cancer mortality data from earlier years to determine if the re-

ported excess risk was present before the Hanford Atomic Energy Facility started operation.

6. No study was made of cancer mortality rates along the north bank of the Columbia River, which is in the State of Washington.

Method of Analysis

Total cancer mortality rates and leukemia mortality rates for groups of counties in Oregon and Washington from 1934 through 1963 were adjusted by the indirect method (4-6) for differences between counties in the age and sex composition of the population (table 1 and fig. 1). The 1950 observed mortality rates for all forms of cancer and for leukemia in the U.S. white population (7) were taken as standard. For the years prior to 1949, the rates include a small adjustment for differences in cause-of-death assignments in the fourth, fifth, and sixth revisions of the International Classification of Diseases (8, 9).

Because the 1960 nonwhite populations were rather small in Oregon (2.1 percent) and Washington (3.6 percent), no adjustment was made for race. The numbers of deaths on which the rates in table 1 are based are shown in table 2.

Table 3 lists the counties included in each area, and figure 2 shows the boundaries of the counties and county groups. Counties in the Metropolitan Portland area were considered separately from the other river counties because of the different cancer risk between urban and rural areas in general (2, 3).

The age-sex-adjusted mortality rates for all forms of cancer and the numbers of deaths upon which these rates were based for Oregon

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and Washington are shown by county in tables 4 and 5. We did not include a similar tabulation of leukemia mortality in this report because the numbers of deaths in most counties were quite small.

Results

Several trends are clear from figure 1. First, total cancer mortality rates in Oregon and Washington have been consistently lower than the average rate for the U.S. white population. In contrast, leukemia mortality rates in both States have been above average for as long as data by county are available (1940 in Oregon and 1934 in Washington). Although the rates

in both States have increased rapidly in recent years, the increase has been about the same as in the rest of the United States. Interestingly, the excess in leukemia mortality existed before the Hanford Preserve began operation in 1945.

Second, total cancer mortality rates in the Portland region of Oregon have remained essentially unchanged since 1935. Mortality in the river counties has increased up to the State average, but remains substantially below that for the entire United States, and mortality in the ocean counties has actually declined. In Washington total cancer mortality in the river counties has been consistently lower than in other parts of the State. Mortality rates for

Table 1. Mortality rates¹ per 100,000 population for all forms of cancer and for leukemia in the United States, Oregon, and Washington, in various time periods

Area	1934-37	1938-42	1943-47	1948-52	1953-57	1958-63
All forms of cancer						
Total United States ² -----	145.6	140.6	138.2	143.8	144.9	³ 141.9
Oregon-----	⁴ 128.8	⁵ 128.8	128.5	129.9	130.5	132.5
River counties-----	⁴ 111.0	⁵ 123.8	112.7	127.3	131.4	133.7
Ocean counties-----	⁴ 133.4	⁵ 120.3	113.5	121.5	123.8	121.8
Portland counties-----	⁴ 143.0	⁵ 137.8	142.3	140.9	138.1	142.4
Inland counties-----	⁴ 112.7	⁵ 121.6	120.3	118.8	122.6	123.8
Washington-----	144.8	136.7	130.2	135.0	139.3	138.5
River counties-----	125.4	121.5	106.0	114.4	125.0	128.9
Ocean counties-----	126.3	126.5	128.7	135.8	127.2	133.7
Portland counties-----	123.9	139.4	134.1	134.9	128.1	137.5
Inland counties-----	149.1	138.8	131.9	136.4	142.0	139.7
Leukemia						
Total United States ² -----	3.4	4.2	4.9	6.1	6.8	³ 7.0
Oregon-----	⁶	⁷ 4.8	5.3	6.2	7.4	7.6
River counties-----	⁶	⁷ 4.8	4.9	5.5	7.3	7.9
Ocean counties-----	⁶	⁷ 5.9	4.2	6.2	8.1	6.2
Portland counties-----	⁶	⁷ 5.6	6.9	7.0	7.5	8.3
Inland counties-----	⁶	⁷ 3.4	3.7	5.3	7.0	7.3
Washington-----	⁸ 3.1	4.1	5.4	6.1	6.9	7.4
River counties-----	⁸ 3.3	2.7	4.6	7.2	6.1	6.1
Ocean counties-----	⁸ 3.1	3.7	4.1	4.9	4.8	7.1
Portland counties-----	⁸ 1.1	3.2	7.4	7.6	6.7	7.4
Inland counties-----	⁸ 3.2	4.3	5.5	6.1	7.2	7.6

¹ Rates adjusted for age and sex by the indirect method, taking U.S. 1950 observed rates for males and females in 10-year age groups as standard.

² Rates for white population only.

³ Rates for 1958-62.

⁴ Rates for 1935 only.

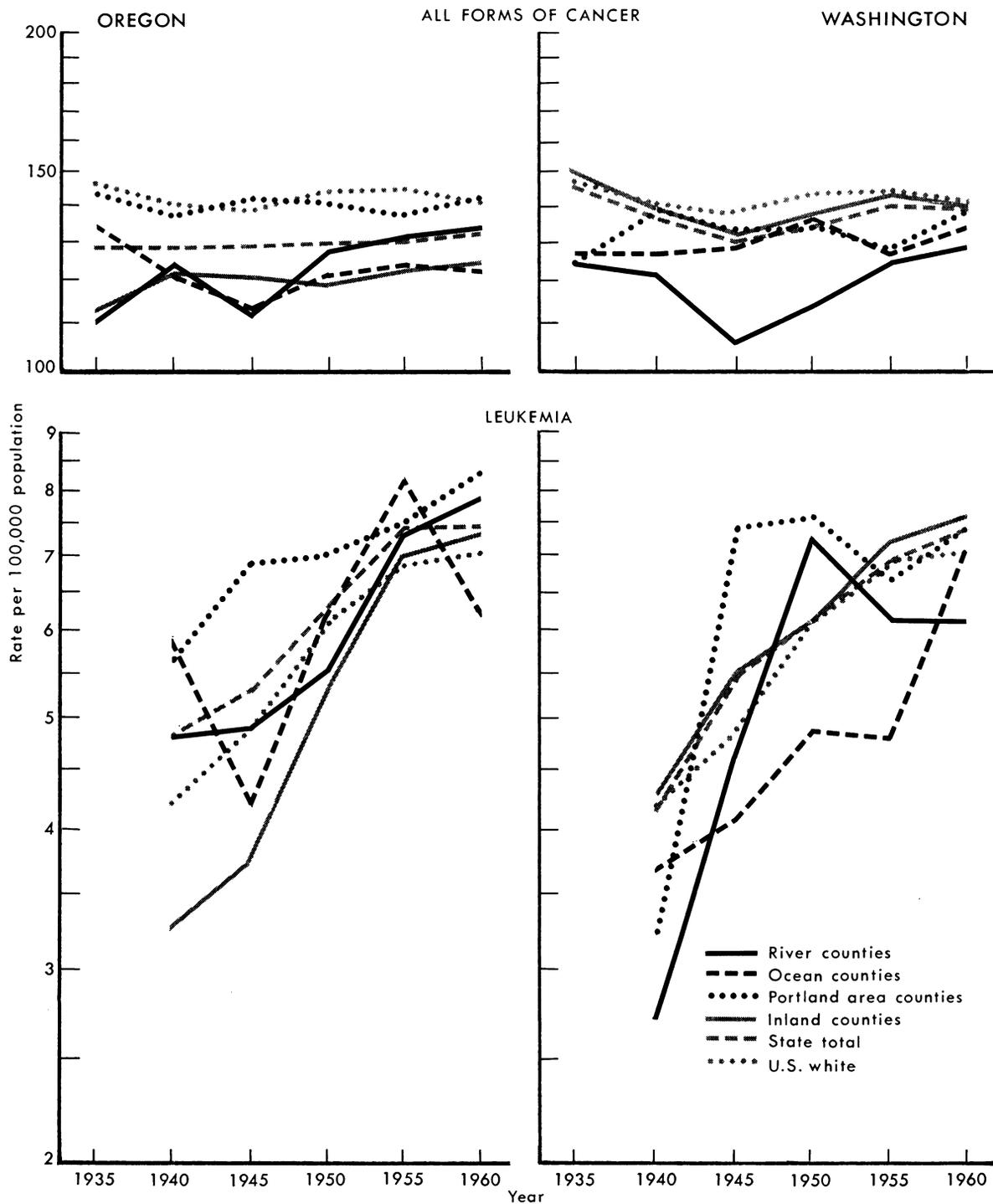
⁵ Rates for 1939-42.

⁶ Leukemia deaths by county not available for these years.

⁷ Rates for 1940-42.

⁸ Rates based on leukemia deaths in 1935 and 1937 only. Leukemia deaths not available by county for 1934 and 1936.

Figure 1. Annual mortality rates per 100,000 population for all forms of cancer and for leukemia, United States, Oregon, and Washington, 1935-60



NOTE: Available leukemia mortality data for 1935-40 are shown in tables 1 and 2.

the ocean counties have also been generally low.

Trends in mortality rates for leukemia are somewhat less clear-cut than trends for total cancer because of the small numbers of deaths in some areas. In Oregon leukemia mortality increased at about the national average in the Portland area, slightly faster in river counties, and even faster in the inland counties. Rates for the ocean counties have fluctuated widely,

but in the most recent period (1958-63) they were the lowest in the State.

In Washington leukemia mortality rates in the river counties increased rapidly before 1950, but they have actually decreased since that time while rates in other parts of the State and in the total United States were rising. Leukemia mortality rates in the ocean counties also have increased rapidly since 1934, but the increase

Table 2. Numbers¹ of deaths from all forms of cancer and from leukemia in the United States, Oregon, and Washington, in various time periods

Area	1934-37	1938-42	1943-47	1948-52	1953-57	1958-63
All forms of cancer						
Total United States ²	527, 601	733, 045	824, 849	969, 037	1, 102, 279	³ 1, 200, 361
Oregon.....	⁴ 1, 229	⁵ 5, 845	8, 659	10, 229	11, 641	15, 832
River counties.....	⁴ 100	⁵ 521	682	878	992	1, 314
Ocean counties.....	⁴ 173	⁵ 754	1, 119	1, 456	1, 746	2, 368
Portland counties.....	⁴ 606	⁵ 2, 786	4, 298	4, 994	5, 495	7, 528
Inland counties.....	⁴ 350	⁵ 1, 784	2, 560	2, 901	3, 408	4, 622
Washington.....	8, 644	12, 127	13, 690	16, 462	19, 130	25, 352
River counties.....	415	593	648	843	1, 068	1, 501
Ocean counties.....	755	1, 080	1, 221	1, 421	1, 448	1, 970
Portland counties.....	204	345	434	541	590	857
Inland counties.....	7, 270	10, 109	11, 387	13, 657	16, 024	21, 024
Leukemia						
Total United States ²	13, 796	22, 985	30, 246	41, 476	51, 036	⁸ 58, 260
Oregon.....	⁽⁶⁾	⁷ 170	354	⁸ 484	648	873
River counties.....	⁽⁶⁾	⁷ 16	30	38	54	74
Ocean counties.....	⁽⁶⁾	⁷ 30	44	79	121	127
Portland counties.....	⁽⁶⁾	⁷ 84	199	234	280	408
Inland counties.....	⁽⁶⁾	⁷ 40	81	132	193	264
Washington.....	⁹ 98	365	573	745	941	1, 342
River counties.....	⁹ 6	14	31	59	56	75
Ocean counties.....	⁹ 10	32	39	50	52	99
Portland counties.....	⁹ 1	8	25	32	31	45
Inland counties.....	⁹ 81	311	478	604	802	1, 123

¹ Numbers which were reported. Before the rates were calculated for table 1, comparability ratios were applied to adjust for differences in cause-of-death assignments between the 4th, 5th, and 6th revisions of the International Classification of Diseases.

² White population only.

³ Data for 1958-62.

⁴ Data for 1935 only.

⁵ Data for 1939-42.

⁶ Data not available by county.

⁷ Data for 1940-42.

⁸ Total includes one with county of residence unknown.

⁹ Data for 1935 and 1937 only. Leukemia deaths not available by county for 1934 and 1936.

SOURCES: Oregon leukemia deaths by county for 1940-57 and deaths due to all forms of cancer by county for 1941-44 were obtained from the State Registrar, Oregon State Board of Health, Portland. Washington leukemia deaths by county for 1935 and 1937-57 and deaths due to all forms of cancer for 1934, 1936-38, and 1941-44 were obtained from the State Registrar, Washington State Board of Health, Olympia. The remainder of the data were obtained from annual volumes of Vital Statistics of the United States.

has been no greater than that of the State as a whole.

No significant trends were observed in individual counties in either Washington or Oregon.

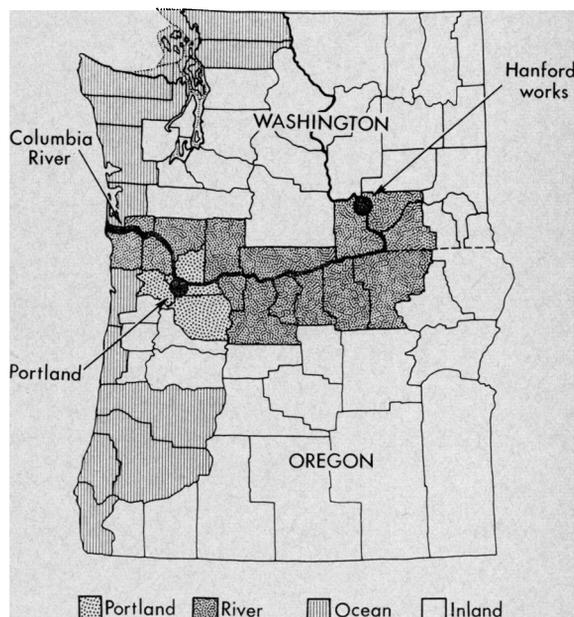
Summary

Because of recent concern over possible contamination of the Columbia River by radioactive products from the Hanford (Washington)

Table 3. Counties in Oregon and Washington, by geographic category

Area	Total counties	Area	Total counties
Oregon-----	36	Washington--	39
<i>River</i> -----	8	<i>River</i> -----	7
Clatsop		Benton	
Columbia		Cowlitz	
Gilliam		Franklin	
Hood River		Klickitat	
Morrow		Skamania	
Sherman		Wahkiakum	
Umatilla		Walla Walla	
Wasco			
<i>Ocean</i> -----	6	<i>Ocean</i> -----	7
Coos		Clallam	
Curry		Grays Harbor	
Douglas		Island	
Lane		Jefferson	
Lincoln		Pacific	
Tillamook		San Juan	
		Whatcom	
<i>Metropolitan Portland</i> -----	3	<i>Metropolitan Portland</i> -----	1
Clackamas		Clark	
Multnomah			
Washington		<i>Inland</i> -----	24
<i>Inland</i> -----	19	Adams	
Baker		Asotin	
Benton		Chelan	
Crook		Columbia	
Deschutes		Douglas	
Grant		Ferry	
Harney		Garfield	
Jackson		Grant	
Jefferson		King	
Josephine		Kitsap	
Klamath		Kittitas	
Lake		Lewis	
Linn		Lincoln	
Malheur		Mason	
Marion		Okanogan	
Polk		Pend Oreille	
Union		Pierce	
Wallowa		Skagit	
Wheeler		Snohomish	
Yamhill		Spokane	
		Stevens	
		Thurston	
		Whitman	
		Yakima	

Figure 2. Counties in Oregon and Washington, by geographic category



Atomic Storage Preserve, an independent study was undertaken to determine cancer trends in Washington and Oregon from 1934 to 1963.

For the analysis, the counties within the two States were divided into four categories: river, ocean, Metropolitan Portland, and inland.

Results of the study revealed that in both States mortality rates for all forms of cancer combined have been consistently below the mortality rate for the U.S. white population. Both States have had a consistent excess in leukemia mortality, but the excess was present before the Hanford Preserve began operation. No important mortality trends were observed in individual counties in either State.

No evidence was found that persons living downstream from the Hanford Preserve or along the Pacific coast of Oregon have had an excess risk of death from cancer in general or from leukemia in particular.

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Table 4. Mortality rates per 100,000 population and numbers of deaths for all forms of cancer by county, in various time periods, Oregon

County	Rates						Numbers					
	1935	1939-42	1943-47	1948-52	1953-57	1958-63	1935	1939-42	1943-47	1948-52	1953-57	1958-63
River:												
Clatsop.....	130.5	132.9	116.6	137.8	154.0	141.3	26	125	163	225	269	315
Columbia.....	119.8	112.3	101.0	129.1	117.5	142.8	20	88	110	156	150	230
Gilliam.....	80.3	89.1	113.1	118.1	102.1	144.6	2	10	16	17	15	26
Hood River.....	102.6	112.5	99.8	86.8	129.7	139.2	9	48	58	55	92	131
Morrow.....	124.3	113.8	133.1	149.0	122.8	119.4	5	20	31	37	32	39
Sherman.....	85.6	77.9	64.8	125.3	127.8	121.3	2	8	8	15	16	19
Umatilla.....	100.0	128.1	116.9	127.5	127.6	126.3	24	143	199	258	291	384
Wasco.....	101.2	143.7	123.6	129.3	126.5	126.7	12	79	97	115	127	170
Ocean:												
Coos.....	130.8	139.6	119.5	133.8	147.5	121.9	32	162	200	256	325	364
Curry.....	143.3	81.0	87.2	136.6	92.4	87.1	5	14	24	46	43	62
Douglas.....	121.8	97.8	110.9	117.8	125.8	119.2	31	117	209	270	334	431
Lane.....	142.9	122.2	111.6	123.5	120.2	124.4	79	328	485	665	776	1,122
Lincoln.....	106.7	112.5	112.6	103.7	112.0	121.0	12	66	108	124	155	228
Tillamook.....	143.0	143.2	129.8	111.0	120.5	131.8	14	67	93	95	113	161
Portland:												
Clackamas.....	127.4	108.5	121.3	122.4	120.5	131.8	67	274	465	557	642	965
Multnomah.....	147.1	144.1	149.7	146.2	143.1	147.8	493	2,302	3,549	4,047	4,367	5,906
Washington.....	128.1	122.3	106.6	121.5	123.4	117.4	46	210	284	390	486	657
Inland:												
Baker.....	131.3	127.4	128.5	120.6	125.4	107.5	21	94	119	113	126	138
Benton.....	125.2	121.9	107.6	95.2	104.0	115.6	20	92	118	120	150	225
Crook.....	115.9	105.6	144.0	88.3	149.1	109.6	4	18	38	28	56	57
Deschutes.....	108.9	121.0	129.6	117.4	111.8	122.6	13	72	110	113	128	195
Grant.....	167.5	125.4	91.7	134.2	112.7	125.8	9	30	30	48	43	61
Harney.....	46.3	73.8	121.6	105.6	124.6	128.1	2	14	31	29	37	49
Jackson.....	101.8	127.8	120.3	119.8	133.0	120.4	36	211	313	379	501	630
Jefferson.....	59.1	121.1	44.2	105.3	95.6	115.8	1	9	6	19	21	36
Josephine.....	156.7	104.5	104.3	127.9	113.4	138.7	25	84	128	187	192	320
Klamath.....	98.3	118.8	126.3	113.0	116.9	132.4	21	125	185	184	219	336
Lake.....	46.3	97.1	91.3	112.7	131.1	141.3	2	20	25	33	42	59
Linn.....	127.1	132.0	117.5	123.4	122.1	119.7	36	173	236	296	330	431
Malheur.....	94.4	85.6	103.7	115.7	124.2	131.8	10	47	84	109	132	187
Marion.....	113.8	131.5	122.4	116.6	119.3	126.9	79	432	593	656	780	1,131
Polk.....	101.6	122.1	122.0	111.8	110.8	113.3	17	95	134	138	152	205
Union.....	112.6	114.5	127.9	135.5	136.6	115.6	17	78	120	140	148	157
Wallowa.....	97.3	132.2	104.3	118.7	115.2	135.1	6	37	37	43	44	65
Wheeler.....	89.7	100.1	126.7	147.5	150.8	122.0	2	10	16	19	19	18
Yamhill.....	110.3	118.0	141.1	132.8	143.5	124.8	29	143	237	247	288	322

SOURCES: Oregon deaths due to all forms of cancer for the years 1941-44 by county were obtained from the State Registrar, Oregon State Board of Health, Portland. The remainder of the data were obtained from respective volumes of Vital Statistics of the United States.

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Table 5. Mortality rates per 100,000 population and numbers of deaths for all forms of cancer by county, in various time periods, Washington

County	Rates						Numbers					
	1934-37	1938-42	1943-47	1948-52	1953-57	1958-63	1934-37	1938-42	1943-47	1948-52	1953-57	1958-63
River:												
Benton.....	79.2	110.0	63.7	101.7	113.4	126.4	34	67	67	153	208	328
Cowlitz.....	137.0	119.3	109.2	127.7	129.3	140.0	131	175	197	274	326	486
Franklin.....	106.4	101.5	128.9	142.5	141.6	125.5	21	30	51	71	96	129
Klickitat.....	99.9	106.3	95.1	123.0	134.1	127.9	36	56	54	75	89	110
Skamania.....	114.2	101.8	85.2	102.4	100.7	97.1	15	21	20	27	28	34
Wahkiakum.....	93.3	118.8	94.5	60.4	91.1	163.9	12	21	19	13	20	44
Walla Walla.....	150.2	140.5	129.3	108.0	128.2	120.4	166	223	240	230	301	370
Ocean:												
Clallam.....	139.9	121.1	108.4	118.7	104.9	134.6	89	112	118	149	152	265
Grays Harbor....	133.0	141.3	138.5	150.7	139.1	151.9	229	346	375	448	444	621
Island.....	131.3	112.8	97.4	161.3	117.2	124.1	37	48	49	94	83	124
Jefferson.....	136.7	112.3	129.5	114.6	159.6	110.9	41	47	60	58	86	76
Pacific.....	117.3	109.7	136.8	122.2	146.3	107.7	61	84	117	116	146	135
San Juan.....	118.5	104.6	95.2	113.9	120.2	111.0	17	21	20	25	29	35
Whatcom.....	118.3	125.9	131.7	133.5	119.4	131.6	281	422	482	531	508	714
Portland: Clark...	123.9	139.4	134.1	134.9	128.1	137.5	204	345	434	541	590	857
Inland:												
Adams.....	108.5	111.4	115.8	85.7	125.3	96.5	23	31	35	28	47	49
Asotin.....	100.1	119.4	126.9	114.1	114.3	121.9	32	53	73	81	91	129
Chelan.....	125.5	126.4	104.4	123.4	124.2	133.4	125	188	179	240	267	376
Columbia.....	160.2	83.8	105.9	159.6	119.6	104.2	34	25	32	49	38	41
Douglas.....	77.3	117.0	89.8	94.0	92.6	103.9	21	46	39	45	53	83
Ferry.....	82.4	114.6	121.7	119.5	134.5	108.6	12	25	26	25	27	25
Garfield.....	72.0	105.5	138.3	131.3	124.9	150.7	9	18	25	25	24	35
Grant.....	86.6	110.9	65.0	103.4	111.1	103.0	24	52	40	79	122	177
King.....	164.1	146.5	142.3	149.8	153.6	148.7	2,926	3,967	4,677	5,809	6,784	8,833
Kitsap.....	145.6	143.9	137.8	146.0	135.2	129.4	208	317	392	511	548	714
Kittitas.....	154.0	117.9	127.7	124.9	117.2	137.4	94	107	130	141	136	196
Lewis.....	144.9	144.6	125.4	129.9	144.4	140.3	210	305	295	338	398	489
Lincoln.....	133.0	129.7	135.6	100.3	116.2	126.5	56	73	80	62	75	102
Mason.....	150.7	154.8	128.4	97.1	156.5	133.3	52	81	81	72	132	151
Okanogan.....	123.8	104.9	117.7	117.0	111.4	131.3	82	105	127	149	151	226
Pend Oreille....	130.2	127.3	107.7	104.9	167.0	112.4	32	45	40	41	68	57
Pierce.....	146.1	142.6	134.8	130.9	140.4	142.8	966	1,397	1,564	1,760	2,096	2,807
Skagit.....	118.3	140.1	126.4	109.6	112.9	111.3	171	298	303	293	328	418
Snohomish.....	142.5	128.0	127.6	134.0	138.2	140.0	455	610	708	850	1,038	1,457
Spokane.....	151.6	137.3	125.3	131.3	138.2	132.6	955	1,271	1,368	1,655	1,960	2,506
Stevens.....	143.4	128.1	93.7	136.5	120.9	120.5	101	127	96	144	130	158
Thurston.....	114.8	126.2	134.0	133.5	137.3	146.5	141	231	282	318	372	533
Whitman.....	170.2	136.7	122.0	118.3	131.0	123.6	161	177	167	171	195	227
Yakima.....	136.8	131.2	120.5	124.8	136.0	133.8	380	560	628	771	944	1,235

SOURCES: Washington deaths due to all forms of cancer for the years 1934, 1936-38, and 1941-44 by county were obtained from the State Registrar, Washington State Board of Health, Olympia. The remainder of the data were obtained from respective volumes of Vital Statistics of the United States.